JP2001060934

PATENT ABSTRACTS OF JAPAN

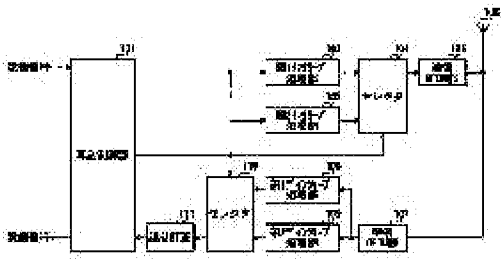
(11)Publication number : 2001-060934
(43)Date of publication of application : 06.03.2001

(51)Int.Cl. H04J 11/00
H03M 13/27
H04L 1/16

(21)Application number : 11-233909
(22)Date of filing : 20.08.1999

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD
(72)Inventor : SUDO HIROAKI

(54) OFDM COMMUNICATION EQUIPMENT



(57)Abstract:
PROBLEM TO BE SOLVED: To reduce the probability of continuous errors in a same transmitting signal by subjecting the transmitting signal to an interleaving processing corresponding to the number of re-transmission of the transmitting signal.
SOLUTION: A re-transmission part 101 stores the transmitting signals and transmits the stored transmitting signals to first and second interleaving processing parts 102 and 103 in a prescribed transmission timing. The first processing part 102 re-arranges the order of the transmitting signals in accordance with a prescribed rule. The second processing part 103 re-arranges the order of the transmitting signals by the prescribed rule being different from the prescribed rule which is used in the first processing part 102. Besides, the re-transmission part 101 outputs a control signal for selecting signals after the interleaving processing is outputted to a selector 104, which are from the first and the second interleaving processing parts 102 and 103, in accordance with the number of transmitting signal re-transmission, that is, whether the transmitting signal is the one to be transmitted for the first time or the one to be re-transmitted.

CLAIMS

[Claim(s)]
[Claim 1]An OFDM sending set comprising:
Two or more interleave means by which interleave processing which is mutually different to a sending signal can be performed.
A selecting means which chooses an interleave means by which interleave processing should be performed to said sending signal, from said two or more interleave means according to the number of resendings of said sending signal, An OFDM means to perform OFDM processing to a sending signal by which interleave processing was carried out by a selected interleave means.

[Claim 2]An OFDM receiving set comprising:
A reception means which receives a signal with which interleave processing according to the number of resendings of a sending signal was made by communications partner, and performs OFDM processing to said signal.
Two or more DEINTA reeve means by which DEINTA reeve processing which is mutually different to a signal by which OFDM processing was carried out can be performed, A selecting means which chooses a DEINTA reeve means to perform DEINTA reeve processing corresponding to said interleave processing, from said two or more DEINTA reeve processing means, and makes a selected interleave means perform DEINTA reeve processing to said signal by which OFDM processing was carried out.

[Claim 3]An OFDM communication device comprising:
The OFDM sending set according to claim 1.
The OFDM receiving set according to claim 2.

[Claim 4]A communication terminal device provided with the OFDM communication device according to claim 3.
[Claim 5]A base station device provided with the OFDM communication device according to claim 4.
[Claim 6]An OFDM correspondence procedure comprising:
An interleave processing process of performing interleave processing according to the number of resendings of a sending signal to said sending signal among two or more interleave processings.
A transmission process which transmits a sending signal which performed OFDM processing to a sending signal with which interleave processing was made, and with which OFDM processing was made via a transmission line.
A receiving process which receives said transmitted signal via said transmission line, and performs OFDM processing to a received signal.
DEINTA reeve down stream processing which performs DEINTA reeve processing corresponding to said performed interleave processing to a signal by which OFDM processing was carried out among two or more DEINTA reeve processings.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the communication apparatus of the OFDM system using especially interleave art about the communication apparatus of the OFDM (Orthogonal Frequency Division Multiplexing) method which performs resending control.
[0002]
[Description of the Prior Art]The resending control by the conventional OFDM communication device using interleave art is explained with reference to drawing 2. Drawing 2 is a block diagram showing the composition of the conventional OFDM communication device using interleave art. Hereafter, the resending control of the conventional OFDM communication device using interleave art is explained taking the case of the case where the 1st communication apparatus and the 2nd communication apparatus provided with both the OFDM communication devices shown in drawing 2 perform radio. The 1st communication apparatus transmits a signal to the 2nd communication apparatus, and here explains the case where the 1st communication apparatus transmits this mistaken signal again to the 2nd communication apparatus (resending), when an error exists in the signal which the 2nd communication apparatus received.
[0003]First, a sending signal is stored in the resending control part 11 in the transmission system of the 1st communication apparatus. This sending signal is a signal of a packet unit. The stored sending signal is transmitted to the interleave processing part 12 by the resending control part 11 according to transmit timing.
[0004]In the interleave processing part 12, an order of the signal transmitted from the resending control part 11 is rearranged in accordance with a specific rule. Predetermined transmitting OFDM processing is made by the transmitting OFDM section 13, and the signal with which an order was rearranged is arranged at each subcarrier.
[0005]As a result of carrying out interleave processing in the interleave processing part 12, the signal with which the above-mentioned predetermined transmitting OFDM processing was made here keeps a predetermined subcarrier interval, and it serves as a signal arranged at each subcarrier. That is, respectively like [the 1st - the 3rd signal in the sending signal inputted into the interleave processing part 12] the subcarrier 1, the subcarrier 5, and the subcarrier 9, for example, 4 subcarrier intervals are kept and the signal with which the above-mentioned predetermined transmitting OFDM processing was made is arranged.
[0006]The signal with which transmitting OFDM processing was made is transmitted to the 2nd communication apparatus via the antenna 14. The signal transmitted from the 1st communication apparatus is received by the 2nd communication apparatus via a transmission line.
[0007]As for the signal received from the antenna 14, predetermined receiving OFDM processing is made by the receiving OFDM section 15 in the 2nd communication apparatus. As for the signal with which the above-mentioned predetermined receiving OFDM processing was made, DEINTA reeve processing is made by the DEINTA reeve

treating part 16. As for the signal with which DEINTA reeve processing was made, error correction processing is made by the error correcting section 17. The signal by which the error correction was carried out is outputted to the resending control part 11.
[0008]In the resending control part 11, when an error does not exist in the signal by which the error correction was carried out, this signal is outputted as an input signal. On the contrary, this signal is stored in a predetermined memory when an error exists in the signal by which the error correction was carried out. Then, after the signal containing the packet of the purport that resending of this signal is required is processed by the interleave processing part 12 and the transmitting OFDM section 13, it is transmitted to the 1st communication apparatus via the antenna 14.
[0009]Then, in the 1st communication apparatus, the packet demanded in resending by the 2nd communication apparatus is transmitted to the interleave processing part 12 in the resending control part 11 according to resending timing. The same processing as what was mentioned above is made, and this packet is resent to the 2nd communication apparatus via the antenna 14.
[0010]The signal with which the error existed [in / as mentioned above / the 2nd communication apparatus] is resent by the 1st communication apparatus.
[0011]
[Problem(s) to be Solved by the Invention]However, there is a problem which is described below in the conventional OFDM communication device using interleave art. That is, the situation where what the signal of inferior quality concentrated at a certain specific time is inputted as a signal which performs error correction processing in the 2nd communication apparatus may occur.
[0012]Here, drawing 3 is referred to in order to explain this situation concretely. Drawing 3 is a mimetic diagram showing an example of arrangement of the subcarrier in the signal received by the conventional OFDM apparatus using interleave art. In the interleave processing part 12 in the 1st communication apparatus, interleave processing as shown in the above-mentioned example shall be made.
[0013]When the signal with which the subcarrier as shown in drawing 3 has been arranged is received by the 2nd communication apparatus, Like the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and --, the signal outputted by the DEINTA reeve treating part 16 sets 4 subcarrier intervals, and it serves as a signal serially taken out from each subcarrier. Here, the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and the signal arranged at -- become what has bad quality so that clearly from drawing 3.
[0014]As a result, since the signal inputted into the error correcting section 17 becomes what the signal of inferior quality concentrated at a certain specific time, the effect of the error correction by the error correcting section 17 decreases, and the signal with which an error exists is outputted to the resending control part 11 by it more often. By this, the 1st communication apparatus will resend the same packet.
[0015]As shown, for example in drawing 4, change of a circuit (transmission line) state the same packet by the 1st communication apparatus to the time interval which transmits in being late, It becomes what is in almost same circuit state when the same above-mentioned packet is transmitted first and circuit state when the same above-mentioned packet is transmitted again (resending).
[0016]In this case, when the signal with which the resent packet was contained is

received by the 2nd communication apparatus, the arrangement state of the subcarrier in this received signal is in the almost same state as what was shown in drawing 3. Therefore, in the 2nd communication apparatus, a possibility that an error will arise becomes very high also about the packet resent by the 1st communication apparatus, and it becomes a situation which the above-mentioned packet mistakes continuously further. Therefore, long time will be taken by the time the 2nd communication apparatus receives a certain specific packet which the 1st communication apparatus transmitted in the state without an error.
[0017]This invention is made in view of this point, and is a thing.
The purpose is to provide the OFDM communication device which can reduce the probability which ** mistakes continuously.

[0018]
[Means for Solving the Problem]An OFDM sending set of this invention is provided with the following.
Two or more interleave means by which interleave processing which is mutually different to a sending signal can be performed.
A selecting means which chooses an interleave means by which interleave processing should be performed to said sending signal, from said two or more interleave means according to the number of resendings of said sending signal.
An OFDM means to perform OFDM processing to a sending signal by which interleave processing was carried out by a selected interleave means.

[0019]According to this invention, since interleave processing according to the number of resendings of a sending signal is performed to the above-mentioned sending signal among several mutually different interleave processings, probability which the same sending signal mistakes continuously can be reduced. Thereby, when a certain specific sending signal is mistaken, time until it receives this specific sending signal in the state without an error can be shortened.
[0020]An OFDM receiving set of this invention is provided with the following.
A reception means which receives a signal with which interleave processing according to the number of resendings of a sending signal was made by communications partner, and performs OFDM processing to said signal.
Two or more DEINTA reeve means by which DEINTA reeve processing which is mutually different to a signal by which OFDM processing was carried out can be performed.
A selecting means which chooses a DEINTA reeve means to perform DEINTA reeve processing corresponding to said interleave processing, from said two or more DEINTA reeve processing means, and makes a selected interleave means perform DEINTA reeve processing to said signal by which OFDM processing was carried out.

[0021]According to this invention, since DEINTA reeve processing according to interleave processing performed to an input signal among several DEINTA reeve processings of being mutually different is performed to the above-mentioned input signal, probability which the same input signal mistakes continuously can be reduced. Thereby, when a certain specific input signal is mistaken, time until it receives this specific input

signal in the state without an error can be shortened.
[0022]An OFDM communication device of this invention possesses the above-mentioned OFDM sending set and the above-mentioned OFDM receiving set.
[0023]Since it has an OFDM sending set which reduces probability which is mistaken succeeding a time of the same sending signal being received by communications partner, and an OFDM receiving set which reduces establishment which the same input signal mistakes continuously according to this invention, An OFDM communication device which can perform good radio can be provided.
[0024]A communication terminal device of this invention was provided with the above-mentioned OFDM communication device. A base station device of this invention was provided with the above-mentioned OFDM communication device.
[0025]According to this invention, since an OFDM communication device which can perform good radio is carried, efficient and good radio can be performed.
[0026]An OFDM correspondence procedure of this invention is provided with the following.
An interleave processing process of performing interleave processing according to the number of resendings of a sending signal to said sending signal among two or more interleave processings.
A transmission process which transmits a sending signal which performed OFDM processing to a sending signal with which interleave processing was made, and with which OFDM processing was made via a transmission line.
A receiving process which receives said transmitted signal via said transmission line, and performs OFDM processing to a received signal, and DEINTA reeve down stream processing which performs DEINTA reeve processing corresponding to said performed interleave processing to a signal by which OFDM processing was carried out among two or more DEINTA reeve processings.

[0027]According to this invention, interleave processing according to the number of resendings of a sending signal is performed to the above-mentioned sending signal among several mutually different interleave processings, Since DEINTA reeve processing corresponding to interleave processing performed to an input signal among several DEINTA reeve processings of being mutually different is performed to the above-mentioned input signal, While being able to reduce probability which the same sending signal mistakes continuously, probability which the same input signal mistakes continuously can be reduced.
[0028]
[Embodiment of the Invention]The subcarrier by which each signal in the sending signal with which OFDM transmitting processing of this invention person was carried out is arranged, In order to change according to the interleave processing made before OFDM transmitting processing, in the receiver, it came to carry out this invention by changing the interleave processing to a sending signal paying attention to the quality of each signal taken out by OFDM reception changing.
[0029]The main point of this invention is having been made to perform interleave processing according to the number of resendings of the sending signal to the sending signal.
[0030]Hereafter, an embodiment of the invention is described in detail with reference to

drawings.
[0031](Embodiment) Drawing 1 is a block diagram showing the composition of the OFDM communication device concerning an embodiment of the invention. Hereafter, the OFDM communication device concerning this embodiment is explained taking the case of the case where the 1st communication apparatus and the 2nd communication apparatus provided with this OFDM communication device both perform radio. The 1st communication apparatus transmits a signal to the 2nd communication apparatus, and here explains the case where the 1st communication apparatus transmits this mistaken signal again to the 2nd communication apparatus (resending), when an error exists in the signal which the 2nd communication apparatus received.
[0032]First, a sending signal is stored in the resending control part 101 in the transmission system of the 1st communication apparatus. This sending signal is a signal of a packet unit, for example. The stored sending signal is transmitted to the 1st interleave processing part 102 and the 2nd interleave processing part 103 by the resending control part 101 according to the transmit timing set up beforehand.
[0033]In the 1st interleave processing part 102, interleave processing is made to the signal transmitted by the resending control part 101. That is, an order of the signal transmitted by the resending control part 101 is rearranged in accordance with a specific rule. The signal with which an order was rearranged by the 1st interleave processing part 102 is outputted to the selector 104.
[0034]In the 2nd interleave processing part 103, interleave processing is made to the signal transmitted by the resending control part 101. That is, an order of the signal transmitted by the resending control part 101 is rearranged in accordance with a specific rule. However, the specific rule used by this 2nd interleave processing part 103 differs from the specific rule used by the 1st interleave processing part 102 mentioned above. The signal with which an order was rearranged by the 2nd interleave processing part 103 is outputted to the selector 104.
[0035]It is possible to use various interleave containing chip interleave, symbol interleave, etc. as an interleaving method by the 1st interleave processing part 102 and the 2nd interleave processing part 103.
[0036]In the selector 104, the signal after the interleave processing outputted by either the 1st interleave processing part 102 or the 2nd interleave processing part 103 is outputted to the transmitting OFDM section 105 according to control by the resending control part 101.
[0037]Specifically, corresponding to the number of resendings of the packet transmitted by the resending control part 101 here, According to whether the packet transmitted by the resending control part 101 is or or the signal resent which is the first signals to be transmitted, The control signal of the purport that either the signal after the interleave processing from the 1st interleave processing part 102 or the signals after the interleave processing from the 2nd interleave processing part 103 should be outputted to the transmitting OFDM section 105 is outputted from the resending control part 101 to the selector 104.
[0038]When the packet transmitted by the resending control part 101 is the first signal to be transmitted in this embodiment, The signal after the interleave processing from the 1st interleave processing part 102 is outputted from the selector 104 to the transmitting OFDM section 105, and when it is a signal resent, the signal after the interleave

processing from the 2nd interleave processing part 103 shall be outputted.
[0039]Predetermined transmitting OFDM processing is made by the transmitting OFDM section 105, and the signal from the selector 104, i.e., the signal, as for, interleave processing was carried out by the 1st interleave processing part 102, is arranged at each subcarrier. Processing of series and null sequence conversion, primary abnormal conditions (QPSK, 16QAM, etc.), IFFT (inverse Fourier transform), etc. is included in this transmitting OFDM processing.
[0040]As a result of carrying out interleave processing in the 1st interleave processing part 102, the signal with which the above-mentioned predetermined transmitting OFDM processing was made here keeps a predetermined subcarrier interval, and it serves as a signal arranged at each subcarrier. Namely, the signal with which the above-mentioned predetermined transmitting OFDM processing was made, Like the subcarrier 1, the subcarrier 5, and the subcarrier 9, for example, 4 subcarrier intervals are set and the 1st - the 4th signal in the signal inputted into the 1st interleave processing part 102 are arranged, respectively.
[0041]The signal with which transmitting OFDM processing was made is transmitted to the 2nd communication apparatus via the antenna 106. The signal transmitted from the 1st communication apparatus is received by the 2nd communication apparatus via a transmission line.
[0042]As for the signal received by the antenna 106, predetermined receiving OFDM processing is made by the receiving OFDM section 107 in the 2nd communication apparatus. Processing of a synchronization, FFT (Fourier transform), transmission diversity, synchronous detection (or differentially coherent detection), a parallel serial conversion, etc. is included in this receiving OFDM processing. The signal with which the above-mentioned predetermined receiving OFDM processing was made is outputted to the 1st DEINTA reeve treating part 108 and the 2nd DEINTA reeve treating part 109.
[0043]In the 1st DEINTA reeve treating part 108, an order of the signal from the receiving OFDM section 107 is rearranged in accordance with a specific rule. This specific rule is equivalent to the specific rule used by the 1st interleave processing part 102 in the 1st communication apparatus. Thereby, an order of the signal from the receiving OFDM section 107 is rearranged so that it may become the same as that of an order at the time of this signal being transmitted by the resending control part 101 in the 1st communication apparatus. The signal with which DEINTA reeve processing was made by the 1st DEINTA reeve treating part 108 is outputted to the selector 110.
[0044]In the 2nd DEINTA reeve treating part 109, an order of the signal from the receiving OFDM section 107 is rearranged in accordance with a specific rule. This specific rule is equivalent to the specific rule used by the 2nd interleave processing part 103 in the 1st communication apparatus. Thereby, an order of the signal from the receiving OFDM section 107 is rearranged so that it may become the same as that of an order at the time of this signal being transmitted by the resending control part 101 in the 1st communication apparatus. The signal with which DEINTA reeve processing was made by the 2nd DEINTA reeve treating part 109 is outputted to the selector 110.
[0045]In the selector 110, the signal after the DEINTA reeve processing outputted by either the 1st DEINTA reeve treating part 108 or the 2nd DEINTA reeve treating part 109 is outputted to the error correcting section 111 according to control by the resending control part 101.

[0046]Specifically, corresponding to the number of reception of the packet received via the antenna 106 here, According to whether the packet received via the antenna 106 is or or the resent signal which is the first signals to be transmitted by the 1st communication apparatus, The control signal of the purport that either the signal after the DEINTA reeve processing from the 1st DEINTA reeve treating part 108 or the signals after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 should be outputted to the error correcting section 111 is outputted from the resending control part 101 to the selector 110.
[0047]When the packet received via the antenna 106 is the first signal to be transmitted by the 1st communication apparatus in this embodiment, The signal after the DEINTA reeve processing from the 1st DEINTA reeve treating part 108 is outputted from the selector 110 to the error correcting section 111, and when it is the resent signal, the signal after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 shall be outputted.
[0048]Error correction processing is made by the error correcting section 111, and the signal from the selector 110, i.e., the signal, as for, DEINTA reeve processing was carried out by the 1st DEINTA reeve treating part 108, is outputted to the resending control part 101 as a signal of a packet unit.
[0049]In the resending control part 101, when an error does not exist in the signal of the packet unit by which the error correction was carried out, this signal is outputted as an input signal. Conversely, when an error exists in the signal of the packet unit by which the error correction was carried out, the signal of this packet unit is stored in a predetermined memory. Then, after the signal containing the packet of the purport that resending of the signal of this packet unit is required is processed by each part of a transmission system, it is transmitted to the 1st communication apparatus via the antenna 106.
[0050]Then, in the 1st received communication apparatus, the signal containing the packet of the purport that the above-mentioned resending is required in the resending control part 101. The signal of the packet unit demanded in resending by the 2nd communication apparatus is transmitted to the 1st interleave processing part 102 and the 2nd interleave processing part 103 according to resending timing. The control signal of the purport that the signal after the interleave processing from the 2nd interleave processing part 103 should be outputted to the transmitting OFDM section 105 from the resending control part 101 to the selector 104 is outputted.
[0051]In the selector 104, the signal after the interleave processing from the 2nd interleave processing part 103 is outputted to the transmitting OFDM section 105 according to the above-mentioned control signal. That is, different interleave processing from the time of being transmitted first is made, and the signal of the packet unit resent is outputted to the transmitting OFDM section 105. Processing which was mentioned above by the transmitting OFDM section 105 is made, and the signal from the selector 104 is transmitted to the 2nd communication apparatus via the antenna 106.
[0052]Here, as a result of carrying out interleave processing in the 2nd interleave processing part 103, the signal after transmitting OFDM processing of the packet resent sets a different subcarrier interval from the time of the first transmission, and it serves as a signal arranged at each subcarrier. Namely, the signal after the above-mentioned transmitting OFDM processing, Like the subcarrier 1, the subcarrier 3, the subcarrier 5,

and the subcarrier 7, for example, 2 subcarrier intervals are set and the 1st - the 4th signal in the signal inputted into the 2nd interleave processing part 103 are arranged, respectively. By this, each signal in the packet resent will be arranged at a different subcarrier from the time of the first transmission.

[0053]In the 2nd communication apparatus, the signal containing the resent packet is received via the antenna 106. The processing as what was mentioned above by each of the receiving OFDM section 107, the 1st DEINTA reeve treating part 108, and the 2nd DEINTA reeve treating part 109 that the signal received via the antenna 106 is the same is made.

[0054]The control signal of the purport that the signal after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 should be outputted to the error correcting section 111 is outputted to the selector 110 from the resending control part 101.

[0055]In the selector 110, the signal after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 is outputted to the error correcting section 111 according to the above-mentioned control signal. That is, different DEINTA reeve processing from the time of being transmitted first is made, and the signal of the resent packet unit is outputted to the error correcting section 111. Error correction processing is made by the error correcting section 111, and the signal from the selector 110 is outputted to the resending control part 101.

[0056]Here, by changing the interleave processing to the specific packet set to the 1st communication apparatus in the time of the first transmission and resending explains again in what kind of state the signal containing this resent packet is received by the 2nd communication apparatus with reference to drawing 3.

[0057]As shown in drawing 3, when a certain specific packet is received for the first time by the 2nd communication apparatus, Like the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and --, the signal outputted from the receiving OFDM section 107 sets 4 subcarrier intervals, and it serves as a signal serially taken out from each subcarrier. Since the signal taken out in this way has the bad quality of the signal arranged at the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and --, it turns into a signal which an error concentrates at a certain specific time, so that clearly from drawing 3.

[0058]On the other hand, when the above-mentioned specific packet is again received by the 2nd communication apparatus, the signal outputted by the receiving OFDM section 107 Like the subcarrier 1, the subcarrier 3, the subcarrier 5, the subcarrier 7, and --, 2 subcarrier intervals are set and it becomes the signal serially taken out from each subcarrier. However, it is considered as the state of the circuit at the time of the above-mentioned specific packet being first received by the 2nd communication apparatus, the state of the circuit at the time of being received again, and what is the same in ****.

[0059]Since a signal of inferior quality and a quality signal turn into a signal included by turns, the signal taken out in this way is a signal with a low possibility that an error will concentrate at a certain specific time, so that clearly from drawing 3. Namely, each signal in a packet specific in the 1st communication apparatus, Since it is transmitted after having been arranged at a mutually different subcarrier when again transmitted with the case where this specific packet is transmitted first, the quality of each signal in the above-mentioned specific packet received by the 2nd communication apparatus becomes that

which differed mutually in above-mentioned each case. the state of the circuit in above-mentioned each case in here -- abbreviated -- the above received by the 2nd communication apparatus since it is the same -- in a specific packet, a possibility that an error will concentrate at a certain specific time becomes low.

[0060]Therefore, in the case where a circuit state with the time of transmission of the beginning of a certain specific packet by the 1st communication apparatus and transmission for the second time hardly changes, a possibility that an error will arise becomes very low in the 2nd communication apparatus about the packet resent by the 1st communication apparatus. That is, the situation which a certain specific packet mistakes continuously in the above-mentioned case is avoidable.

[0061]In this embodiment, although the case where an interleave processing part and two DEINTA reeve treating parts were prepared, respectively was explained, this invention is not limited to this but can be applied also to the case where the number of an interleave processing part and DEINTA reeve treating parts is increased further. In this case, what is necessary is just to use two or more interleave processing parts and DEINTA reeve treating parts which were prepared according to the number of resendings of the packet which transmits. The probability which the same packet mistakes continuously by this can be reduced still more certainly.

[0062]The 1st communication apparatus transmitted the signal to the 2nd communication apparatus, in this embodiment, when an error existed in the signal which the 2nd communication apparatus received, explained the case where the 1st communication apparatus transmitted this mistaken signal again to the 2nd communication apparatus (resending), but. Since both the 1st communication apparatus and the 2nd communication apparatus have the composition shown in drawing 1, this invention, The 2nd communication apparatus transmits a signal to the 1st communication apparatus, and when an error exists in the signal which the 1st communication apparatus received, this mistaken signal can be applied also to the case where the 2nd communication apparatus transmits again to the 1st communication apparatus.

[0063]Thus, according to this embodiment, two or more the interleave processing parts and DEINTA reeve treating parts which perform interleave which is mutually different are prepared, respectively, The probability which the same packet mistakes continuously can be reduced by using the interleave processing part and DEINTA reeve treating part of the above-mentioned plurality, namely, changing an interleaving method according to the number of resendings of the packet which transmits. Thereby, when a certain specific packet is mistaken, time until it receives this specific packet in the state without an error can be shortened.

[0064]Although the case where interleave processing was changed according to the number of resendings of a certain packet was explained in this embodiment, This invention is not limited to this but can be applied also to the case where the interleave processing part and DEINTA reeve treating part which were prepared are properly used according to various conditions, such as line quality. The probability which the packet which received mistakes by this can be reduced.

[0065]The OFDM communication device concerning an embodiment of the invention can be carried in the communication terminal device and base station device in a digital mobile communications system.

[0066]

[Effect of the Invention]As explained above, since it was made to perform interleave processing according to the number of resendings of the sending signal to the sending signal according to this invention, the OFDM communication device which can reduce the probability which the same packet mistakes continuously can be provided.

TECHNICAL FIELD

[Field of the Invention]This invention relates to the communication apparatus of the OFDM system using especially interleave art about the communication apparatus of the OFDM (Orthogonal Frequency Division Multiplexing) method which performs resending control.

PRIOR ART

[Description of the Prior Art]The resending control by the conventional OFDM communication device using interleave art is explained with reference to drawing 2. Drawing 2 is a block diagram showing the composition of the conventional OFDM communication device using interleave art. Hereafter, the resending control of the conventional OFDM communication device using interleave art is explained taking the case of the case where the 1st communication apparatus and the 2nd communication apparatus provided with both the OFDM communication devices shown in drawing 2 perform radio. The 1st communication apparatus transmits a signal to the 2nd communication apparatus, and here explains the case where the 1st communication apparatus transmits this mistaken signal again to the 2nd communication apparatus (resending), when an error exists in the signal which the 2nd communication apparatus received.

[0003]First, a sending signal is stored in the resending control part 11 in the transmission system of the 1st communication apparatus. This sending signal is a signal of a packet unit. The stored sending signal is transmitted to the interleave processing part 12 by the resending control part 11 according to transmit timing.

[0004]In the interleave processing part 12, an order of the signal transmitted from the resending control part 11 is rearranged in accordance with a specific rule. Predetermined transmitting OFDM processing is made by the transmitting OFDM section 13, and the signal with which an order was rearranged is arranged at each subcarrier.

[0005]As a result of carrying out interleave processing in the interleave processing part 12, the signal with which the above-mentioned predetermined transmitting OFDM processing was made here keeps a predetermined subcarrier interval, and it serves as a signal arranged at each subcarrier. That is, respectively like [the 1st - the 3rd signal in the sending signal inputted into the interleave processing part 12] the subcarrier 1, the subcarrier 5, and the subcarrier 9, for example, 4 subcarrier intervals are kept and the signal with which the above-mentioned predetermined transmitting OFDM processing was made is arranged.

[0006]The signal with which transmitting OFDM processing was made is transmitted to

the 2nd communication apparatus via the antenna 14. The signal transmitted from the 1st communication apparatus is received by the 2nd communication apparatus via a transmission line.
[0007]As for the signal received from the antenna 14, predetermined receiving OFDM processing is made by the receiving OFDM section 15 in the 2nd communication apparatus. As for the signal with which the above-mentioned predetermined receiving OFDM processing was made, DEINTA reeve processing is made by the DEINTA reeve treating part 16. As for the signal with which DEINTA reeve processing was made, error correction processing is made by the error correcting section 17. The signal by which the error correction was carried out is outputted to the resending control part 11.
[0008]In the resending control part 11, when an error does not exist in the signal by which the error correction was carried out, this signal is outputted as an input signal. On the contrary, this signal is stored in a predetermined memory when an error exists in the signal by which the error correction was carried out. Then, after the signal containing the packet of the purport that resending of this signal is required is processed by the interleave processing part 12 and the transmitting OFDM section 13, it is transmitted to the 1st communication apparatus via the antenna 14.
[0009]Then, in the 1st communication apparatus, the packet demanded in resending by the 2nd communication apparatus is transmitted to the interleave processing part 12 in the resending control part 11 according to resending timing. The same processing as what was mentioned above is made, and this packet is resent to the 2nd communication apparatus via the antenna 14.
[0010]The signal with which the error existed [in / as mentioned above / the 2nd communication apparatus] is resent by the 1st communication apparatus.

EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, in this invention, it was made to perform interleave processing according to the number of resendings of the sending signal to the sending signal.
Therefore, the OFDM communication device which can reduce the probability which the same packet mistakes continuously can be provided.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, there is a problem which is described below in the conventional OFDM communication device using interleave art. That is, the situation where what the signal of inferior quality concentrated at a certain specific time is inputted as a signal which performs error correction processing in the 2nd communication apparatus may occur.
[0012]Here, drawing 3 is referred to in order to explain this situation concretely. Drawing 3 is a mimetic diagram showing an example of arrangement of the subcarrier in the signal received by the conventional OFDM apparatus using interleave art. In the interleave processing part 12 in the 1st communication apparatus, interleave processing as shown in

the above-mentioned example shall be made.
[0013]When the signal with which the subcarrier as shown in drawing 3 has been arranged is received by the 2nd communication apparatus, Like the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and --, the signal outputted by the DEINTA reeve treating part 16 sets 4 subcarrier intervals, and it serves as a signal serially taken out from each subcarrier. Here, the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and the signal arranged at -- become what has bad quality so that clearly from drawing 3.
[0014]As a result, since the signal inputted into the error correcting section 17 becomes what the signal of inferior quality concentrated at a certain specific time, the effect of the error correction by the error correcting section 17 decreases, and the signal with which an error exists is outputted to the resending control part 11 by it more often. By this, the 1st communication apparatus will resend the same packet.
[0015]As shown, for example in drawing 4, change of a circuit (transmission line) state the same packet by the 1st communication apparatus to the time interval which transmits in being late, It becomes what is in almost same circuit state when the same above-mentioned packet is transmitted first and circuit state when the same above-mentioned packet is transmitted again (resending).
[0016]In this case, when the signal with which the resent packet was contained is received by the 2nd communication apparatus, the arrangement state of the subcarrier in this received signal is in the almost same state as what was shown in drawing 3. Therefore, in the 2nd communication apparatus, a possibility that an error will arise becomes very high also about the packet resent by the 1st communication apparatus, and it becomes a situation which the above-mentioned packet mistakes continuously further. Therefore, long time will be taken by the time the 2nd communication apparatus receives a certain specific packet which the 1st communication apparatus transmitted in the state without an error.
[0017]This invention is made in view of this point, and is a thing.
The purpose is to provide the OFDM communication device which can reduce the probability which ** mistakes continuously.

MEANS

[Means for Solving the Problem]An OFDM sending set of this invention is provided with the following.
Two or more interleave means by which interleave processing which is mutually different to a sending signal can be performed.
A selecting means which chooses an interleave means by which interleave processing should be performed to said sending signal, from said two or more interleave means according to the number of resendings of said sending signal.
An OFDM means to perform OFDM processing to a sending signal by which interleave processing was carried out by a selected interleave means.

[0019]According to this invention, since interleave processing according to the number of resendings of a sending signal is performed to the above-mentioned sending signal

among several mutually different interleave processings, probability which the same sending signal mistakes continuously can be reduced. Thereby, when a certain specific sending signal is mistaken, time until it receives this specific sending signal in the state without an error can be shortened.
[0020]An OFDM receiving set of this invention is provided with the following.
A reception means which receives a signal with which interleave processing according to the number of resendings of a sending signal was made by communications partner, and performs OFDM processing to said signal.
Two or more DEINTA reeve means by which DEINTA reeve processing which is mutually different to a signal by which OFDM processing was carried out can be performed.
A selecting means which chooses a DEINTA reeve means to perform DEINTA reeve processing corresponding to said interleave processing, from said two or more DEINTA reeve processing means, and makes a selected interleave means perform DEINTA reeve processing to said signal by which OFDM processing was carried out.

[0021]According to this invention, since DEINTA reeve processing according to interleave processing performed to an input signal among several DEINTA reeve processings of being mutually different is performed to the above-mentioned input signal, probability which the same input signal mistakes continuously can be reduced. Thereby, when a certain specific input signal is mistaken, time until it receives this specific input signal in the state without an error can be shortened.
[0022]An OFDM communication device of this invention possesses the above-mentioned OFDM sending set and the above-mentioned OFDM receiving set.
[0023]Since it has an OFDM sending set which reduces probability which is mistaken succeeding a time of the same sending signal being received by communications partner, and an OFDM receiving set which reduces establishment which the same input signal mistakes continuously according to this invention, An OFDM communication device which can perform good radio can be provided.
[0024]A communication terminal device of this invention was provided with the above-mentioned OFDM communication device. A base station device of this invention was provided with the above-mentioned OFDM communication device.
[0025]According to this invention, since an OFDM communication device which can perform good radio is carried, efficient and good radio can be performed.
[0026]An OFDM correspondence procedure of this invention is provided with the following.
An interleave processing process of performing interleave processing according to the number of resendings of a sending signal to said sending signal among two or more interleave processings.
A transmission process which transmits a sending signal which performed OFDM processing to a sending signal with which interleave processing was made, and with which OFDM processing was made via a transmission line.
A receiving process which receives said transmitted signal via said transmission line, and performs OFDM processing to a received signal, and DEINTA reeve down stream processing which performs DEINTA reeve processing corresponding to said performed interleave processing to a signal by which OFDM processing was carried out among two

or more DEINTA reeve processings.

[0027]According to this invention, interleave processing according to the number of resendings of a sending signal is performed to the above-mentioned sending signal among several mutually different interleave processings, Since DEINTA reeve processing corresponding to interleave processing performed to an input signal among several DEINTA reeve processings of being mutually different is performed to the above-mentioned input signal, While being able to reduce probability which the same sending signal mistakes continuously, probability which the same input signal mistakes continuously can be reduced.
[0028]
[Embodiment of the Invention]The subcarrier by which each signal in the sending signal with which OFDM transmitting processing of this invention person was carried out is arranged, In order to change according to the interleave processing made before OFDM transmitting processing, in the receiver, it came to carry out this invention by changing the interleave processing to a sending signal paying attention to the quality of each signal taken out by OFDM reception changing.
[0029]The main point of this invention is having been made to perform interleave processing according to the number of resendings of the sending signal to the sending signal.
[0030]Hereafter, an embodiment of the invention is described in detail with reference to drawings.
[0031](Embodiment) Drawing 1 is a block diagram showing the composition of the OFDM communication device concerning an embodiment of the invention. Hereafter, the OFDM communication device concerning this embodiment is explained taking the case of the case where the 1st communication apparatus and the 2nd communication apparatus provided with this OFDM communication device both perform radio. The 1st communication apparatus transmits a signal to the 2nd communication apparatus, and here explains the case where the 1st communication apparatus transmits this mistaken signal again to the 2nd communication apparatus (resending), when an error exists in the signal which the 2nd communication apparatus received.
[0032]First, a sending signal is stored in the resending control part 101 in the transmission system of the 1st communication apparatus. This sending signal is a signal of a packet unit, for example. The stored sending signal is transmitted to the 1st interleave processing part 102 and the 2nd interleave processing part 103 by the resending control part 101 according to the transmit timing set up beforehand.
[0033]In the 1st interleave processing part 102, interleave processing is made to the signal transmitted by the resending control part 101. That is, an order of the signal transmitted by the resending control part 101 is rearranged in accordance with a specific rule. The signal with which an order was rearranged by the 1st interleave processing part 102 is outputted to the selector 104.
[0034]In the 2nd interleave processing part 103, interleave processing is made to the signal transmitted by the resending control part 101. That is, an order of the signal transmitted by the resending control part 101 is rearranged in accordance with a specific rule. However, the specific rule used by this 2nd interleave processing part 103 differs from the specific rule used by the 1st interleave processing part 102 mentioned above.

The signal with which an order was rearranged by the 2nd interleave processing part 103 is outputted to the selector 104.
[0035]It is possible to use various interleave containing chip interleave, symbol interleave, etc. as an interleaving method by the 1st interleave processing part 102 and the 2nd interleave processing part 103.
[0036]In the selector 104, the signal after the interleave processing outputted by either the 1st interleave processing part 102 or the 2nd interleave processing part 103 is outputted to the transmitting OFDM section 105 according to control by the resending control part 101.
[0037]Specifically, corresponding to the number of resendings of the packet transmitted by the resending control part 101 here, According to whether the packet transmitted by the resending control part 101 is or or the signal resent which is the first signals to be transmitted, The control signal of the purport that either the signal after the interleave processing from the 1st interleave processing part 102 or the signals after the interleave processing from the 2nd interleave processing part 103 should be outputted to the transmitting OFDM section 105 is outputted from the resending control part 101 to the selector 104.
[0038]When the packet transmitted by the resending control part 101 is the first signal to be transmitted in this embodiment, The signal after the interleave processing from the 1st interleave processing part 102 is outputted from the selector 104 to the transmitting OFDM section 105, and when it is a signal resent, the signal after the interleave processing from the 2nd interleave processing part 103 shall be outputted.
[0039]Predetermined transmitting OFDM processing is made by the transmitting OFDM section 105, and the signal from the selector 104, i.e., the signal, as for, interleave processing was carried out by the 1st interleave processing part 102, is arranged at each subcarrier. Processing of series and null sequence conversion, primary abnormal conditions (QPSK, 16QAM, etc.), IFFT (inverse Fourier transform), etc. is included in this transmitting OFDM processing.
[0040]As a result of carrying out interleave processing in the 1st interleave processing part 102, the signal with which the above-mentioned predetermined transmitting OFDM processing was made here keeps a predetermined subcarrier interval, and it serves as a signal arranged at each subcarrier. Namely, the signal with which the above-mentioned predetermined transmitting OFDM processing was made, Like the subcarrier 1, the subcarrier 5, and the subcarrier 9, for example, 4 subcarrier intervals are set and the 1st - the 4th signal in the signal inputted into the 1st interleave processing part 102 are arranged, respectively.
[0041]The signal with which transmitting OFDM processing was made is transmitted to the 2nd communication apparatus via the antenna 106. The signal transmitted from the 1st communication apparatus is received by the 2nd communication apparatus via a transmission line.
[0042]As for the signal received by the antenna 106, predetermined receiving OFDM processing is made by the receiving OFDM section 107 in the 2nd communication apparatus. Processing of a synchronization, FFT (Fourier transform), transmission diversity, synchronous detection (or differentially coherent detection), a parallel serial conversion, etc. is included in this receiving OFDM processing. The signal with which the above-mentioned predetermined receiving OFDM processing was made is outputted

to the 1st DEINTA reeve treating part 108 and the 2nd DEINTA reeve treating part 109.
[0043]In the 1st DEINTA reeve treating part 108, an order of the signal from the receiving OFDM section 107 is rearranged in accordance with a specific rule. This specific rule is equivalent to the specific rule used by the 1st interleave processing part 102 in the 1st communication apparatus. Thereby, an order of the signal from the receiving OFDM section 107 is rearranged so that it may become the same as that of an order at the time of this signal being transmitted by the resending control part 101 in the 1st communication apparatus. The signal with which DEINTA reeve processing was made by the 1st DEINTA reeve treating part 108 is outputted to the selector 110.
[0044]In the 2nd DEINTA reeve treating part 109, an order of the signal from the receiving OFDM section 107 is rearranged in accordance with a specific rule. This specific rule is equivalent to the specific rule used by the 2nd interleave processing part 103 in the 1st communication apparatus. Thereby, an order of the signal from the receiving OFDM section 107 is rearranged so that it may become the same as that of an order at the time of this signal being transmitted by the resending control part 101 in the 1st communication apparatus. The signal with which DEINTA reeve processing was made by the 2nd DEINTA reeve treating part 109 is outputted to the selector 110.
[0045]In the selector 110, the signal after the DEINTA reeve processing outputted by either the 1st DEINTA reeve treating part 108 or the 2nd DEINTA reeve treating part 109 is outputted to the error correcting section 111 according to control by the resending control part 101.
[0046]Specifically, corresponding to the number of reception of the packet received via the antenna 106 here, According to whether the packet received via the antenna 106 is or or the resent signal which is the first signals to be transmitted by the 1st communication apparatus, The control signal of the purport that either the signal after the DEINTA reeve processing from the 1st DEINTA reeve treating part 108 or the signals after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 should be outputted to the error correcting section 111 is outputted from the resending control part 101 to the selector 110.
[0047]When the packet received via the antenna 106 is the first signal to be transmitted by the 1st communication apparatus in this embodiment, The signal after the DEINTA reeve processing from the 1st DEINTA reeve treating part 108 is outputted from the selector 110 to the error correcting section 111, and when it is the resent signal, the signal after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 shall be outputted.
[0048]Error correction processing is made by the error correcting section 111, and the signal from the selector 110, i.e., the signal, as for, DEINTA reeve processing was carried out by the 1st DEINTA reeve treating part 108, is outputted to the resending control part 101 as a signal of a packet unit.
[0049]In the resending control part 101, when an error does not exist in the signal of the packet unit by which the error correction was carried out, this signal is outputted as an input signal. Conversely, when an error exists in the signal of the packet unit by which the error correction was carried out, the signal of this packet unit is stored in a predetermined memory. Then, after the signal containing the packet of the purport that resending of the signal of this packet unit is required is processed by each part of a transmission system, it is transmitted to the 1st communication apparatus via the antenna

106.
[0050]Then, in the 1st received communication apparatus, the signal containing the packet of the purport that the above-mentioned resending is required in the resending control part 101. The signal of the packet unit demanded in resending by the 2nd communication apparatus is transmitted to the 1st interleave processing part 102 and the 2nd interleave processing part 103 according to resending timing. The control signal of the purport that the signal after the interleave processing from the 2nd interleave processing part 103 should be outputted to the transmitting OFDM section 105 from the resending control part 101 to the selector 104 is outputted.
[0051]In the selector 104, the signal after the interleave processing from the 2nd interleave processing part 103 is outputted to the transmitting OFDM section 105 according to the above-mentioned control signal. That is, different interleave processing from the time of being transmitted first is made, and the signal of the packet unit resent is outputted to the transmitting OFDM section 105. Processing which was mentioned above by the transmitting OFDM section 105 is made, and the signal from the selector 104 is transmitted to the 2nd communication apparatus via the antenna 106.
[0052]Here, as a result of carrying out interleave processing in the 2nd interleave processing part 103, the signal after transmitting OFDM processing of the packet resent sets a different subcarrier interval from the time of the first transmission, and it serves as a signal arranged at each subcarrier. Namely, the signal after the above-mentioned transmitting OFDM processing, Like the subcarrier 1, the subcarrier 3, the subcarrier 5, and the subcarrier 7, for example, 2 subcarrier intervals are set and the 1st - the 4th signal in the signal inputted into the 2nd interleave processing part 103 are arranged, respectively. By this, each signal in the packet resent will be arranged at a different subcarrier from the time of the first transmission.
[0053]In the 2nd communication apparatus, the signal containing the resent packet is received via the antenna 106. The processing as what was mentioned above by each of the receiving OFDM section 107, the 1st DEINTA reeve treating part 108, and the 2nd DEINTA reeve treating part 109 that the signal received via the antenna 106 is the same is made.
[0054]The control signal of the purport that the signal after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 should be outputted to the error correcting section 111 is outputted to the selector 110 from the resending control part 101.
[0055]In the selector 110, the signal after the DEINTA reeve processing from the 2nd DEINTA reeve treating part 109 is outputted to the error correcting section 111 according to the above-mentioned control signal. That is, different DEINTA reeve processing from the time of being transmitted first is made, and the signal of the resent packet unit is outputted to the error correcting section 111. Error correction processing is made by the error correcting section 111, and the signal from the selector 110 is outputted to the resending control part 101.
[0056]Here, by changing the interleave processing to the specific packet set to the 1st communication apparatus in the time of the first transmission and resending explains again in what kind of state the signal containing this resent packet is received by the 2nd communication apparatus with reference to drawing 3.
[0057]As shown in drawing 3, when a certain specific packet is received for the first time

by the 2nd communication apparatus, Like the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and --, the signal outputted from the receiving OFDM section 107 sets 4 subcarrier intervals, and it serves as a signal serially taken out from each subcarrier. Since the signal taken out in this way has the bad quality of the signal arranged at the subcarrier 1, the subcarrier 5, the subcarrier 9, the subcarrier 13, and --, it turns into a signal which an error concentrates at a certain specific time, so that clearly from drawing 3.

[0058]On the other hand, when the above-mentioned specific packet is again received by the 2nd communication apparatus, the signal outputted by the receiving OFDM section 107 Like the subcarrier 1, the subcarrier 3, the subcarrier 5, the subcarrier 7, and --, 2 subcarrier intervals are set and it becomes the signal serially taken out from each subcarrier. However, it is considered as the state of the circuit at the time of the above-mentioned specific packet being first received by the 2nd communication apparatus, the state of the circuit at the time of being received again, and what is the same in ****.

[0059]Since a signal of inferior quality and a quality signal turn into a signal included by turns, the signal taken out in this way is a signal with a low possibility that an error will concentrate at a certain specific time, so that clearly from drawing 3. Namely, each signal in a packet specific in the 1st communication apparatus, Since it is transmitted after having been arranged at a mutually different subcarrier when again transmitted with the case where this specific packet is transmitted first, the quality of each signal in the above-mentioned specific packet received by the 2nd communication apparatus becomes that which differed mutually in above-mentioned each case. the state of the circuit in above-mentioned each case in here -- abbreviated -- the above received by the 2nd communication apparatus since it is the same -- in a specific packet, a possibility that an error will concentrate at a certain specific time becomes low.

[0060]Therefore, in the case where a circuit state with the time of transmission of the beginning of a certain specific packet by the 1st communication apparatus and transmission for the second time hardly changes, a possibility that an error will arise becomes very low in the 2nd communication apparatus about the packet resent by the 1st communication apparatus. That is, the situation which a certain specific packet mistakes continuously in the above-mentioned case is avoidable.

[0061]In this embodiment, although the case where an interleave processing part and two DEINTA reeve treating parts were prepared, respectively was explained, this invention is not limited to this but can be applied also to the case where the number of an interleave processing part and DEINTA reeve treating parts is increased further. In this case, what is necessary is just to use two or more interleave processing parts and DEINTA reeve treating parts which were prepared according to the number of resendings of the packet which transmits. The probability which the same packet mistakes continuously by this can be reduced still more certainly.

[0062]The 1st communication apparatus transmitted the signal to the 2nd communication apparatus, in this embodiment, when an error existed in the signal which the 2nd communication apparatus received, explained the case where the 1st communication apparatus transmitted this mistaken signal again to the 2nd communication apparatus (resending), but. Since both the 1st communication apparatus and the 2nd communication apparatus have the composition shown in drawing 1, this invention, The 2nd communication apparatus transmits a signal to the 1st communication apparatus, and

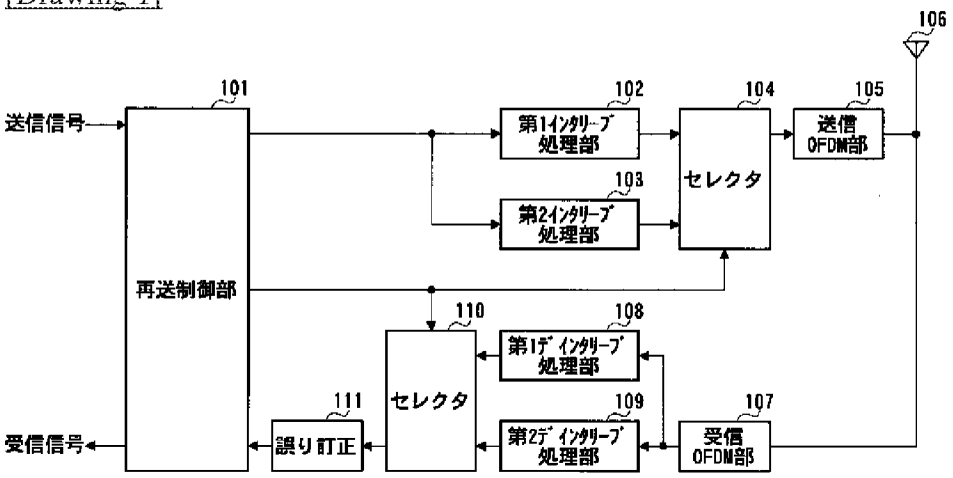
when an error exists in the signal which the 1st communication apparatus received, this mistaken signal can be applied also to the case where the 2nd communication apparatus transmits again to the 1st communication apparatus.
[0063]Thus, according to this embodiment, two or more the interleave processing parts and DEINTA reeve treating parts which perform interleave which is mutually different are prepared, respectively, The probability which the same packet mistakes continuously can be reduced by using the interleave processing part and DEINTA reeve treating part of the above-mentioned plurality, namely, changing an interleaving method according to the number of resendings of the packet which transmits. Thereby, when a certain specific packet is mistaken, time until it receives this specific packet in the state without an error can be shortened.
[0064]Although the case where interleave processing was changed according to the number of resendings of a certain packet was explained in this embodiment, This invention is not limited to this but can be applied also to the case where the interleave processing part and DEINTA reeve treating part which were prepared are properly used according to various conditions, such as line quality. The probability which the packet which received mistakes by this can be reduced.
[0065]The OFDM communication device concerning an embodiment of the invention can be carried in the communication terminal device and base station device in a digital mobile communications system.

DESCRIPTION OF DRAWINGS

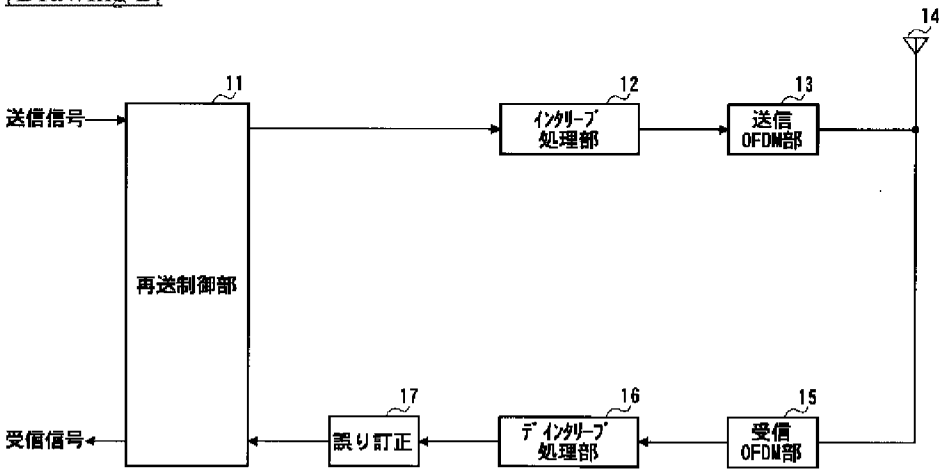
[Brief Description of the Drawings]
[Drawing 1]The block diagram showing the composition of the OFDM communication device concerning an embodiment of the invention
[Drawing 2]The block diagram showing the composition of the conventional OFDM communication device using interleave art
[Drawing 3]The mimetic diagram showing an example of arrangement of the subcarrier in the signal received by the OFDM apparatus using interleave art
[Drawing 4]The mimetic diagram showing the state of the circuit which the conventional OFDM communication device using interleave art uses
[Description of Notations]
101 Resending control part
102 The 1st interleave processing part
103 The 2nd interleave processing part
104 Selector
105 Transmitting OFDM section
106 Antenna
107 Receiving OFDM section
108 The 1st DEINTA reeve treating part
109 The 2nd DEINTA reeve treating part
110 Selector

DRAWINGS

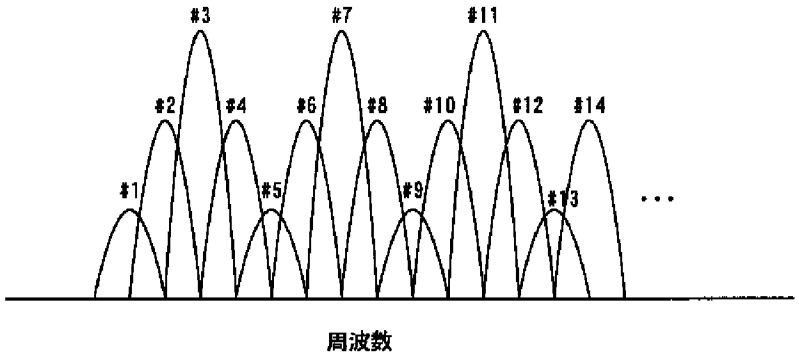
[Drawing 1]



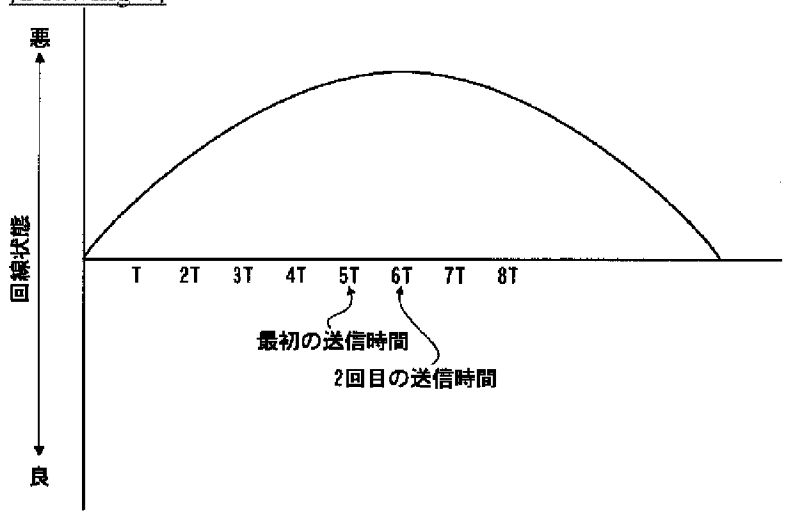
[Drawing 2]



[Drawing 3]



[Drawing 4]



(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号
特開2001－60934
（P2001－60934A）
(43)公開日　平成13年３月６日(2001.3.6)

(51)Int.Cl.[7]	識別記号	ＦＩ		ﾃｰﾏｺｰﾄﾞ(参考)
Ｈ０４Ｊ　11/00		Ｈ０４Ｊ　11/00	Ｚ	５Ｊ０６５
Ｈ０３Ｍ　13/27		Ｈ０３Ｍ　13/27		５Ｋ０１４
Ｈ０４Ｌ　1/16		Ｈ０４Ｌ　1/16		５Ｋ０２２

審査請求　未請求　請求項の数６　ＯＬ　（全　８　頁）

(21)出願番号　特願平11－233909

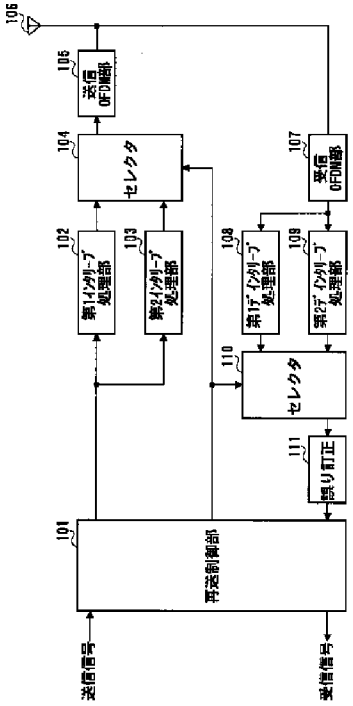
(22)出願日　平成11年８月20日(1999.8.20)

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地
(72)発明者　須藤　浩章
神奈川県横浜市港北区綱島東四丁目３番１号　松下通信工業株式会社内
(74)代理人　100105050
弁理士　鷲田　公一

Ｆターム(参考)　5J065 AB02 AC02 AD03 AE02 AG06
AH09 AH20
5K014 AA01 BA05 FA11 FA16
5K022 DD00 DD13 DD19 DD22 DD32

(54)【発明の名称】　ＯＦＤＭ通信装置

(57)【要約】
【課題】　同一のパケットが連続して誤る確率を低減させることが可能なＯＦＤＭ通信装置を提供すること。
【解決手段】　送信信号に対して相互に異なるインタリーブ処理を実行可能な複数のインタリーブ手段と、前記送信信号の再送数に応じて、前記複数のインタリーブ手段の中から前記送信信号に対してインタリーブ処理を実行すべきインタリーブ手段を選択する選択手段と、選択されたインタリーブ手段によりインタリーブ処理された送信信号に対してＯＦＤＭ処理を行うＯＦＤＭ手段と、を具備する。



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【特許請求の範囲】

【請求項１】　送信信号に対して相互に異なるインタリーブ処理を実行可能な複数のインタリーブ手段と、前記送信信号の再送数に応じて、前記複数のインタリーブ手段の中から前記送信信号に対してインタリーブ処理を実行すべきインタリーブ手段を選択する選択手段と、選択されたインタリーブ手段によりインタリーブ処理された送信信号に対してＯＦＤＭ処理を行うＯＦＤＭ手段と、を具備することを特徴とするＯＦＤＭ送信装置。

【請求項２】　通信相手により送信信号の再送数に応じたインタリーブ処理がなされた信号を受信し、前記信号に対してＯＦＤＭ処理を行う受信手段と、ＯＦＤＭ処理された信号に対して相互に異なるデインタリーブ処理を実行可能な複数のデインタリーブ手段と、前記複数のデインタリーブ処理手段の中から前記インタリーブ処理に対応したデインタリーブ処理を行うデインタリーブ手段を選択し、選択されたインタリーブ手段に前記ＯＦＤＭ処理された信号に対するデインタリーブ処理を実行させる選択手段と、を具備することを特徴とするＯＦＤＭ受信装置。

【請求項３】　請求項１に記載のＯＦＤＭ送信装置と、請求項２に記載のＯＦＤＭ受信装置と、を具備することを特徴とするＯＦＤＭ通信装置。

【請求項４】　請求項３に記載のＯＦＤＭ通信装置を備えたことを特徴とする通信端末装置。

【請求項５】　請求項４に記載のＯＦＤＭ通信装置を備えたことを特徴とする基地局装置。

【請求項６】　複数のインタリーブ処理のうち送信信号の再送数に応じたインタリーブ処理を前記送信信号に対して実行するインタリーブ処理工程と、インタリーブ処理がなされた送信信号に対してＯＦＤＭ処理を行い、ＯＦＤＭ処理がなされた送信信号を伝送路を介して送信する送信工程と、前記送信された信号を前記伝送路を介して受信し、受信した信号に対してＯＦＤＭ処理を行う受信工程と、複数のデインタリーブ処理のうち前記実行されたインタリーブ処理に対応したデインタリーブ処理を、ＯＦＤＭ処理された信号に対して実行するデインタリーブ処理工程と、を具備することを特徴とするＯＦＤＭ通信方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、再送制御を行うＯＦＤＭ（Ｏｒｔｈｏｇｏｎａｌ　Ｆｒｅｑｕｅｎｃｙ　Ｄｉｖｉｓｉｏｎ　Ｍｕｌｔｉｐｌｅｘｉｎｇ）方式の通信装置に関し、特にインタリーブ技術を利用したＯＦＤＭ方式の通信装置に関する。

【０００２】

【従来の技術】インタリーブ技術を利用した従来のＯＦＤＭ通信装置による再送制御について、図２を参照して説明する。図２は、インタリーブ技術を利用した従来のＯＦＤＭ通信装置の構成を示すブロック図である。以下、インタリーブ技術を利用した従来のＯＦＤＭ通信装置の再送制御について、図２に示すＯＦＤＭ通信装置をともに備えた第１通信装置と第２通信装置とが無線通信を行う場合を例にとり説明する。なお、ここでは、第１通信装置が第２通信装置に対して信号を送信し、第２通信装置が受信した信号に誤りが存在した際に、この誤った信号を、第１通信装置が第２通信装置に対して、再度送信（再送）する場合について説明する。

2

【０００３】まず、第１通信装置の送信系において、送信信号は、再送制御部１１に格納される。この送信信号は、パケット単位の信号である。格納された送信信号は、送信タイミングに従って、再送制御部１１によりインタリーブ処理部１２に送信される。

【０００４】インタリーブ処理部１２では、再送制御部１１より送信された信号の順序が、特定の規則に従って並びかえられる。順序が並びかえられた信号は、送信ＯＦＤＭ部１３により、所定の送信ＯＦＤＭ処理がなされて、各サブキャリアに配置される。

【０００５】ここで、上記所定の送信ＯＦＤＭ処理がなされた信号というのは、インタリーブ処理部１２でインタリーブ処理された結果、所定のサブキャリア間隔を置いて、各サブキャリアに配置された信号となっている。すなわち、上記所定の送信ＯＦＤＭ処理がなされた信号は、インタリーブ処理部１２に入力された送信信号における１番目～３番目の信号が、それぞれ、サブキャリア１、サブキャリア５、サブキャリア９、というように、例えば、４サブキャリア間隔を置いて配置される。

【０００６】送信ＯＦＤＭ処理がなされた信号は、アンテナ１４を介して第２通信装置に送信される。第１通信装置から送信された信号は、伝送路を介して、第２通信装置により受信される。

【０００７】第２通信装置において、アンテナ１４より受信された信号は、受信ＯＦＤＭ部１５により、所定の受信ＯＦＤＭ処理がなされる。上記所定の受信ＯＦＤＭ処理がなされた信号は、デインタリーブ処理部１６によりデインタリーブ処理がなされる。デインタリーブ処理がなされた信号は、誤り訂正部１７により誤り訂正処理がなされる。誤り訂正された信号は、再送制御部１１に出力される。

【０００８】再送制御部１１において、誤り訂正された信号に誤りが存在しない場合には、この信号は受信信号として出力される。逆に、誤り訂正された信号に誤りが存在する場合には、この信号は所定のメモリに格納される。この後、この信号の再送を要求する旨のパケットを含む信号が、インタリーブ処理部１２および送信ＯＦＤＭ部１３により処理された後、アンテナ１４を介して第１通信装置に対して送信される。

【０００９】この後、第１通信装置において、再送制御部１１では、第２通信装置により再送の要求をされたパ

ケットは、再送タイミングに従って、インタリーブ処理部１２に送信される。このパケットは、上述したものと同様の処理がなされて、アンテナ１４を介して第２通信装置に対して再送される。

【００１０】以上のようにして、第２通信装置において誤りが存在した信号は、第１通信装置により再送される。

【００１１】

【発明が解決しようとする課題】しかしながら、インタリーブ技術を利用した従来のＯＦＤＭ通信装置においては、下記に述べるような問題がある。すなわち、第２通信装置において誤り訂正処理を行う信号として、ある特定の時間に品質の悪い信号が集中したものが入力される状況が発生する場合がある。

【００１２】ここで、この状況を具体的に説明するために、図３を参照する。図３は、インタリーブ技術を利用した従来のＯＦＤＭ装置により受信された信号におけるサブキャリアの配置の一例を示す模式図である。なお、第１通信装置におけるインタリーブ処理部１２では、上記例に示したようなインタリーブ処理がなされているものとする。

【００１３】図３に示すようなサブキャリアが配置された信号が第２通信装置により受信されたときには、デインタリーブ処理部１６により出力される信号というのは、サブキャリア１、サブキャリア５、サブキャリア９、サブキャリア１３、…というように、４サブキャリア間隔をおいて、各サブキャリアから時系列的に取り出された信号となる。ここで、図３から明らかなように、サブキャリア１、サブキャリア５、サブキャリア９、サブキャリア１３、…に配置された信号は、品質が悪いものとなる。

【００１４】この結果、誤り訂正部１７に入力される信号は、ある特定の時間に品質の悪い信号が集中したものとなるので、誤り訂正部１７による誤り訂正の効果が低減して、誤りの存在する信号が再送制御部１１に出力されることが多くなる。これにより、第１通信装置が同一のパケットを再送することになる。

【００１５】さらに、回線（伝送路）状態の変動が、例えば図４に示すように、第１通信装置による同一パケットを送信する時間間隔に対して遅い場合には、上記同一パケットが最初に送信されたときの回線状態と、上記同一パケットが再度送信（再送）されたときの回線状態とは、ほぼ同じようなものとなる。

【００１６】この場合には、再送されたパケットが含まれた信号が第２通信装置により受信された際において、この受信された信号におけるサブキャリアの配置状態は、図３に示したものとほぼ同様な状態である。したがって、第２通信装置において、第１通信装置により再送されたパケットについても誤りが生ずる可能性が非常に高くなり、さらには、上記パケットが連続して誤る事態となる。したがって、第１通信装置が送信したある特定のパケットを、第２通信装置が誤りなしの状態で受信するまでに、長い時間がかかることになる。

【００１７】本発明は、かかる点に鑑みてなされたものであり、同一のパケットが連続して誤る確率を低減させることが可能なＯＦＤＭ通信装置を提供することを目的とする。

【００１８】

【課題を解決するための手段】本発明のＯＦＤＭ送信装置は、送信信号に対して相互に異なるインタリーブ処理を実行可能な複数のインタリーブ手段と、前記送信信号の再送数に応じて、前記複数のインタリーブ手段の中から前記送信信号に対してインタリーブ処理を実行すべきインタリーブ手段を選択する選択手段と、選択されたインタリーブ手段によりインタリーブ処理された送信信号に対してＯＦＤＭ処理を行うＯＦＤＭ手段と、を具備することを特徴とする。

【００１９】本発明によれば、相互に異なる複数のインタリーブ処理のうち、送信信号の再送数に応じたインタリーブ処理を上記送信信号に対して行うので、同一の送信信号が連続して誤る確率を低減させることができる。これにより、ある特定の送信信号が誤った場合において、この特定の送信信号を誤りなしの状態で受信するまでの時間を短縮することができる。

【００２０】本発明のＯＦＤＭ受信装置は、通信相手により送信信号の再送数に応じたインタリーブ処理がなされた信号を受信し、前記信号に対してＯＦＤＭ処理を行う受信手段と、ＯＦＤＭ処理された信号に対して相互に異なるデインタリーブ処理を実行可能な複数のデインタリーブ手段と、前記複数のデインタリーブ処理手段の中から前記インタリーブ処理に対応したデインタリーブ処理を行うデインタリーブ手段を選択し、選択されたインタリーブ手段に前記ＯＦＤＭ処理された信号に対するデインタリーブ処理を実行させる選択手段と、を具備することを特徴とする。

【００２１】本発明によれば、相互に異なる複数のデインタリーブ処理のうち、受信信号に対して施されたインタリーブ処理に応じたデインタリーブ処理を上記受信信号に対して行うので、同一の受信信号が連続して誤る確率を低減させることができる。これにより、ある特定の受信信号が誤った場合において、この特定の受信信号を誤りなしの状態で受信するまでの時間を短縮することができる。

【００２２】本発明のＯＦＤＭ通信装置は、上記ＯＦＤＭ送信装置と、上記ＯＦＤＭ受信装置と、を具備することを特徴とする。

【００２３】本発明によれば、同一の送信信号が通信相手により受信されたときに連続して誤る確率を低減させるＯＦＤＭ送信装置と、同一の受信信号が連続して誤る確立を低減させるＯＦＤＭ受信装置と、を備えるので、

良好な無線通信を行うことができるＯＦＤＭ通信装置を提供することができる。

【００２４】本発明の通信端末装置は、上記ＯＦＤＭ通信装置を備えたことを特徴とする。本発明の基地局装置は、上記ＯＦＤＭ通信装置を備えたことを特徴とする。

【００２５】本発明によれば、良好な無線通信を行うことが可能なＯＦＤＭ通信装置を搭載するので、効率的かつ良好な無線通信を行うことができる。

【００２６】本発明のＯＦＤＭ通信方法は、複数のインタリーブ処理のうち送信信号の再送数に応じたインタリーブ処理を前記送信信号に対して実行するインタリーブ処理工程と、インタリーブ処理がなされた送信信号に対してＯＦＤＭ処理を行い、ＯＦＤＭ処理がなされた送信信号を伝送路を介して送信する送信工程と、前記送信された信号を前記伝送路を介して受信し、受信した信号に対してＯＦＤＭ処理を行う受信工程と、複数のデインタリーブ処理のうち前記実行されたインタリーブ処理に対応したデインタリーブ処理を、ＯＦＤＭ処理された信号に対して実行するデインタリーブ処理工程と、を具備することを特徴とする。

【００２７】本発明によれば、相互に異なる複数のインタリーブ処理のうち、送信信号の再送数に応じたインタリーブ処理を上記送信信号に対して行い、また、相互に異なる複数のデインタリーブ処理のうち、受信信号に施されたインタリーブ処理に対応したデインタリーブ処理を上記受信信号に対して行うので、同一の送信信号が連続して誤る確率を低減させることができるとともに、同一の受信信号が連続して誤る確率を低減させることができる。

【００２８】

【発明の実施の形態】本発明者は、ＯＦＤＭ送信処理された送信信号における各信号が配置されるサブキャリアは、ＯＦＤＭ送信処理前になされるインタリーブ処理に応じて変化するため、送信信号に対するインタリーブ処理を変化させることにより、受信側において、ＯＦＤＭ受信処理により取り出される各信号の品質が変化することに着目して、本発明をするに至った。

【００２９】本発明の骨子は、送信信号の再送数に応じたインタリーブ処理を送信信号に対して行うようにしたことである。

【００３０】以下、本発明の実施の形態について、図面を参照して詳細に説明する。

【００３１】（実施の形態）図１は、本発明の実施の形態に係るＯＦＤＭ通信装置の構成を示すブロック図である。以下、本実施の形態に係るＯＦＤＭ通信装置について、このＯＦＤＭ通信装置をともに備えた第１通信装置と第２通信装置とが無線通信を行う場合を例にとり説明する。なお、ここでは、第１通信装置が第２通信装置に対して信号を送信し、第２通信装置が受信した信号に誤りが存在した際に、この誤った信号を、第１通信装置が第２通信装置に対して、再度送信（再送）する場合について説明する。

【００３２】まず、第１通信装置の送信系において、送信信号は、再送制御部１０１に格納される。この送信信号は、例えばパケット単位の信号である。格納された送信信号は、あらかじめ設定されている送信タイミングに従って、再送制御部１０１により第１インタリーブ処理部１０２および第２インタリーブ処理部１０３に送信される。

【００３３】第１インタリーブ処理部１０２では、再送制御部１０１により送信された信号に対してインタリーブ処理がなされる。すなわち、再送制御部１０１により送信された信号の順序が、特定の規則に従って並びかえられる。第１インタリーブ処理部１０２により順序が並びかえられた信号は、セレクタ１０４に出力される。

【００３４】第２インタリーブ処理部１０３では、再送制御部１０１により送信された信号に対してインタリーブ処理がなされる。すなわち、再送制御部１０１により送信された信号の順序が、特定の規則に従って並びかえられる。ただし、この第２インタリーブ処理部１０３により用いられる特定の規則は、上述した第１インタリーブ処理部１０２により用いられる特定の規則と異なるものである。第２インタリーブ処理部１０３により順序が並びかえられた信号は、セレクタ１０４に出力される。

【００３５】第１インタリーブ処理部１０２および第２インタリーブ処理部１０３によるインタリーブ方法として、チップインタリーブやシンボルインタリーブ等を含む様々なインタリーブを用いることが可能である。

【００３６】セレクタ１０４では、再送制御部１０１による制御に従って、第１インタリーブ処理部１０２または第２インタリーブ処理部１０３のいずれかにより出力されたインタリーブ処理後の信号が送信ＯＦＤＭ部１０５に出力される。

【００３７】具体的には、再送制御部１０１により送信されるパケットの再送数に応じて、すなわち、ここでは、再送制御部１０１により送信されるパケットが、初めて送信される信号であるか再送される信号であるかに応じて、第１インタリーブ処理部１０２からのインタリーブ処理後の信号または第２インタリーブ処理部１０３からのインタリーブ処理後の信号のうちのいずれかを送信ＯＦＤＭ部１０５に出力すべき旨の制御信号が、再送制御部１０１よりセレクタ１０４に対して出力される。

【００３８】なお、本実施の形態においては、再送制御部１０１により送信されるパケットが、初めて送信される信号である場合には、セレクタ１０４より送信ＯＦＤＭ部１０５に対して、第１インタリーブ処理部１０２からのインタリーブ処理後の信号が出力され、また、再送される信号である場合には、第２インタリーブ処理部１０３からのインタリーブ処理後の信号が出力されるものとする。

【００３９】セレクタ１０４からの信号、すなわち、第１インタリーブ処理部１０２によりインタリーブ処理された信号は、送信ＯＦＤＭ部１０５により、所定の送信ＯＦＤＭ処理がなされて、各サブキャリアに配置される。この送信ＯＦＤＭ処理には、直列・零列変換、１次変調（ＱＰＳＫや１６ＱＡＭ等）およびＩＦＦＴ（逆フーリエ変換）等の処理が含まれる。

【００４０】ここで、上記所定の送信ＯＦＤＭ処理がなされた信号というのは、第１インタリーブ処理部１０２でインタリーブ処理された結果、所定のサブキャリア間隔を置いて、各サブキャリアに配置された信号となっている。すなわち、上記所定の送信ＯＦＤＭ処理がなされた信号は、第１インタリーブ処理部１０２に入力された信号における１番目～４番目の信号が、それぞれ、サブキャリア１、サブキャリア５およびサブキャリア９、というように、例えば、４サブキャリア間隔をおいて配置される。

【００４１】送信ＯＦＤＭ処理がなされた信号は、アンテナ１０６を介して第２通信装置に送信される。第１通信装置から送信された信号は、伝送路を介して、第２通信装置により受信される。

【００４２】第２通信装置において、アンテナ１０６により受信された信号は、受信ＯＦＤＭ部１０７により、所定の受信ＯＦＤＭ処理がなされる。この受信ＯＦＤＭ処理には、同期、ＦＦＴ（フーリエ変換）、送信ダイバーシチ、同期検波（あるいは遅延検波）および並列直列変換等の処理が含まれる。上記所定の受信ＯＦＤＭ処理がなされた信号は、第１デインタリーブ処理部１０８および第２デインタリーブ処理部１０９に出力される。

【００４３】第１デインタリーブ処理部１０８では、受信ＯＦＤＭ部１０７からの信号の順序が、特定の規則に従って並びかえられる。この特定の規則は、第１通信装置における第１インタリーブ処理部１０２により用いられた特定の規則に対応するものである。これにより、受信ＯＦＤＭ部１０７からの信号の順序は、この信号が第１通信装置における再送制御部１０１により送信された際における順序と同一となるように並びかえられる。第１デインタリーブ処理部１０８によりデインタリーブ処理がなされた信号は、セレクタ１１０に出力される。

【００４４】第２デインタリーブ処理部１０９では、受信ＯＦＤＭ部１０７からの信号の順序が、特定の規則に従って並びかえられる。この特定の規則は、第１通信装置における第２インタリーブ処理部１０３により用いられた特定の規則に対応するものである。これにより、受信ＯＦＤＭ部１０７からの信号の順序は、この信号が第１通信装置における再送制御部１０１により送信された際における順序と同一となるように並びかえられる。第２デインタリーブ処理部１０９によりデインタリーブ処理がなされた信号は、セレクタ１１０に出力される。

【００４５】セレクタ１１０では、再送制御部１０１による制御に従って、第１デインタリーブ処理部１０８または第２デインタリーブ処理部１０９のいずれかにより出力されたデインタリーブ処理後の信号が誤り訂正部１１１に出力される。

【００４６】具体的には、アンテナ１０６を介して受信されたパケットの受信数に応じて、すなわち、ここでは、アンテナ１０６を介して受信されたパケットが、第１通信装置により初めて送信された信号であるか再送された信号であるかに応じて、第１デインタリーブ処理部１０８からのデインタリーブ処理後の信号または第２デインタリーブ処理部１０９からのデインタリーブ処理後の信号のうちのいずれかを誤り訂正部１１１に出力すべき旨の制御信号が、再送制御部１０１よりセレクタ１１０に対して出力される。

【００４７】なお、本実施の形態においては、アンテナ１０６を介して受信されるパケットが、第１通信装置により初めて送信された信号である場合には、セレクタ１１０より誤り訂正部１１１に対して、第１デインタリーブ処理部１０８からのデインタリーブ処理後の信号が出力され、また、再送された信号である場合には、第２デインタリーブ処理部１０９からのデインタリーブ処理後の信号が出力されるものとする。

【００４８】セレクタ１１０からの信号、すなわち、第１デインタリーブ処理部１０８によりデインタリーブ処理された信号は、誤り訂正部１１１により誤り訂正処理がなされパケット単位の信号として、再送制御部１０１に出力される。

【００４９】再送制御部１０１において、誤り訂正されたパケット単位の信号に誤りが存在しない場合には、この信号は受信信号として出力される。逆に誤り訂正されたパケット単位の信号に誤りが存在する場合には、このパケット単位の信号は所定のメモリに格納される。この後、このパケット単位の信号の再送を要求する旨のパケットを含む信号が、送信系の各部により処理された後、アンテナ１０６を介して第１通信装置に対して送信される。

【００５０】この後、上記再送を要求する旨のパケットを含む信号を受信した第１通信装置において、再送制御部１０１では、第２通信装置により再送の要求をされたパケット単位の信号は、再送タイミングに従って、第１インタリーブ処理部１０２および第２インタリーブ処理部１０３に送信される。さらに、再送制御部１０１よりセレクタ１０４に対して、第２インタリーブ処理部１０３からのインタリーブ処理後の信号を送信ＯＦＤＭ部１０５に出力すべき旨の制御信号が出力される。

【００５１】セレクタ１０４では、上記制御信号に従って、第２インタリーブ処理部１０３からのインタリーブ処理後の信号が送信ＯＦＤＭ部１０５に出力される。すなわち、再送されるパケット単位の信号は、最初に送信された際とは異なるインタリーブ処理がなされて、送信

ＯＦＤＭ部１０５に出力される。セレクタ１０４からの信号は、送信ＯＦＤＭ部１０５により上述したような処理がなされてアンテナ１０６を介して第２通信装置に送信される。

【００５２】ここで、再送されるパケットの送信ＯＦＤＭ処理後の信号というのは、第２インタリーブ処理部１０３でインタリーブ処理された結果、最初の送信時とは異なるサブキャリア間隔をおいて、各サブキャリアに配置された信号となっている。すなわち、上記送信ＯＦＤＭ処理後の信号は、第２インタリーブ処理部１０３に入力された信号における１番目～４番目の信号が、それぞれ、サブキャリア１、サブキャリア３、サブキャリア５およびサブキャリア７、というように、例えば、２サブキャリア間隔をおいて配置される。これにより、再送されるパケットにおける各信号は、最初の送信時とは異なるサブキャリアに配置されることになる。

【００５３】第２通信装置において、再送されたパケットを含む信号は、アンテナ１０６を介して受信される。アンテナ１０６を介して受信された信号は、受信ＯＦＤＭ部１０７、第１デインタリーブ処理部１０８および第２デインタリーブ処理部１０９のそれぞれにより上述したものと同様の処理がなされる。

【００５４】セレクタ１１０には、再送制御部１０１より、第２デインタリーブ処理部１０９からのデインタリーブ処理後の信号を誤り訂正部１１１に出力すべき旨の制御信号が出力される。

【００５５】セレクタ１１０では、上記制御信号に従って、第２デインタリーブ処理部１０９からのデインタリーブ処理後の信号が誤り訂正部１１１に出力される。すなわち、再送されたパケット単位の信号は、最初に送信された際とは異なるデインタリーブ処理がなされて、誤り訂正部１１１に出力される。セレクタ１１０からの信号は、誤り訂正部１１１により誤り訂正処理がなされて再送制御部１０１に出力される。

【００５６】ここで、第１通信装置においてある特定のパケットに対するインタリーブ処理を、最初の送信時と再送時とで変化させることにより、再送されたこのパケットを含む信号が第２通信装置によりどのような状態で受信されるかについて、再度図３を参照して説明する。

【００５７】図３に示したように、ある特定のパケットが第２通信装置により初めて受信されたときには、受信ＯＦＤＭ部１０７より出力される信号というのは、サブキャリア１、サブキャリア５、サブキャリア９、サブキャリア１３、…というように、４サブキャリア間隔をおいて、各サブキャリアから時系列的に取り出された信号となる。図３から明らかなように、このように取り出された信号は、サブキャリア１、サブキャリア５、サブキャリア９、サブキャリア１３、…に配置された信号の品質が悪いため、ある特定の時間に誤りが集中する信号となる。

【００５８】一方、上記特定のパケットが第２通信装置により再度受信されたとき、受信ＯＦＤＭ部１０７により出力される信号というのは、サブキャリア１、サブキャリア３、サブキャリア５、サブキャリア７、…というように、２サブキャリア間隔をおいて、各サブキャリアから時系列的に取り出された信号となる。ただし、第２通信装置により上記特定のパケットが、最初に受信された時点における回線の状態と、再度受信された時点における回線の状態と、は略同一であるものとする。

【００５９】図３から明らかなように、このように取り出された信号は、品質の悪い信号と品質の良い信号とが交互に含まれた信号となるので、ある特定の時間に誤りが集中する可能性が低い信号となっている。すなわち、第１通信装置では、特定のパケットにおける各信号は、この特定のパケットが最初に送信される場合と再度送信される場合とにおいて、相互に異なるサブキャリアに配置された後に送信されているので、第２通信装置により受信された上記特定のパケットにおける各信号の品質は、上記各場合において相互に異なったものとなる。ここで、上記各場合における回線の状態は略同一であるので、第２通信装置により受信される上記特定のパケットにおいては、ある特定の時間に誤りが集中する可能性が低くなる。

【００６０】したがって、第１通信装置によるある特定のパケットの最初の送信時と再度の送信時との回線状態がほとんど変化しない場合において、第２通信装置において、第１通信装置により再送されたパケットについて、誤りが生ずる可能性が非常に低くなる。すなわち、上記場合において、ある特定のパケットが連続して誤る事態を回避することができる。

【００６１】なお、本実施の形態においては、インタリーブ処理部およびデインタリーブ処理部をそれぞれ２つ用意した場合について説明したが、本発明は、これに限定されず、インタリーブ処理部およびデインタリーブ処理部の数をさらに増やした場合についても適用可能なものである。この場合には、用意した複数のインタリーブ処理部およびデインタリーブ処理部を、送信するパケットの再送数に応じて使用するようにすればよい。これにより、同一のパケットが連続して誤る確率をさらに確実に低減させることができる。

【００６２】また、本実施の形態においては、第１通信装置が第２通信装置に対して信号を送信し、第２通信装置が受信した信号に誤りが存在した際に、この誤った信号を、第１通信装置が第２通信装置に対して、再度送信（再送）する場合について説明したが、第１通信装置および第２通信装置は、ともに図１に示した構成を有するので、本発明は、第２通信装置が第１通信装置に対して信号を送信し、第１通信装置が受信した信号に誤りが存在した際に、この誤った信号を、第２通信装置が第１通信装置に対して、再度送信する場合についても適用可能

なものである。

【００６３】このように、本実施の形態によれば、相互に異なるインタリーブを行うインタリーブ処理部およびデインタリーブ処理部をそれぞれ複数用意し、送信するパケットの再送数に応じて、上記複数のインタリーブ処理部およびデインタリーブ処理部を用いる、すなわち、インタリーブ方法を変えることにより、同一のパケットが連続して誤る確率を低減させることができる。これにより、ある特定のパケットが誤った場合において、この特定のパケットを誤りなしの状態で受信するまでの時間を短縮することができる。

【００６４】なお、本実施の形態においては、あるパケットの再送数に応じてインタリーブ処理を変化させる場合について説明したが、本発明は、これに限定されず、複数用意したインタリーブ処理部およびデインタリーブ処理部を、回線品質等の様々な条件に応じて、使い分けるようにした場合についても適用可能である。これにより、受信したパケットが誤る確率を低減させることができる。

【００６５】さらに、本発明の実施の形態に係るＯＦＤＭ通信装置は、ディジタル移動体通信システムにおける通信端末装置や基地局装置に搭載可能なものである。

【００６６】

【発明の効果】以上説明したように、本発明によれば、送信信号の再送数に応じたインタリーブ処理を送信信号に対して行うようにしたので、同一のパケットが連続して誤る確率を低減させることが可能なＯＦＤＭ通信装置を提供することができる。

【図面の簡単な説明】

【図１】本発明の実施の形態に係るＯＦＤＭ通信装置の構成を示すブロック図

【図２】インタリーブ技術を利用した従来のＯＦＤＭ通信装置の構成を示すブロック図

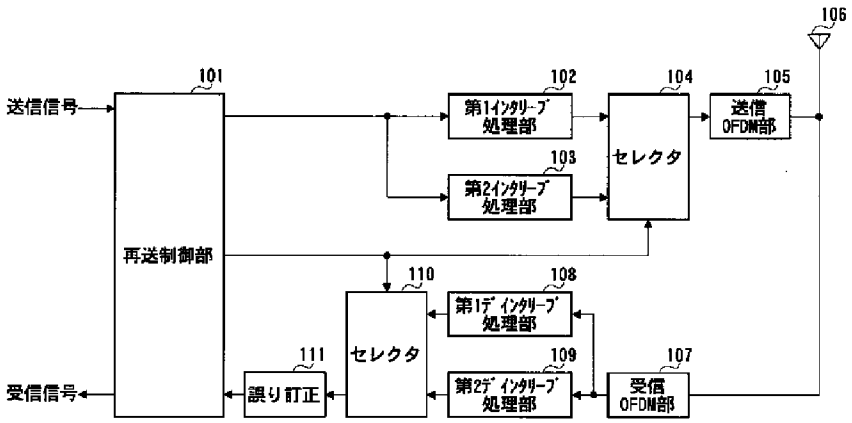
【図３】インタリーブ技術を利用したＯＦＤＭ装置により受信された信号におけるサブキャリアの配置の一例を示す模式図

【図４】インタリーブ技術を利用した従来のＯＦＤＭ通信装置が用いる回線の状態を示す模式図

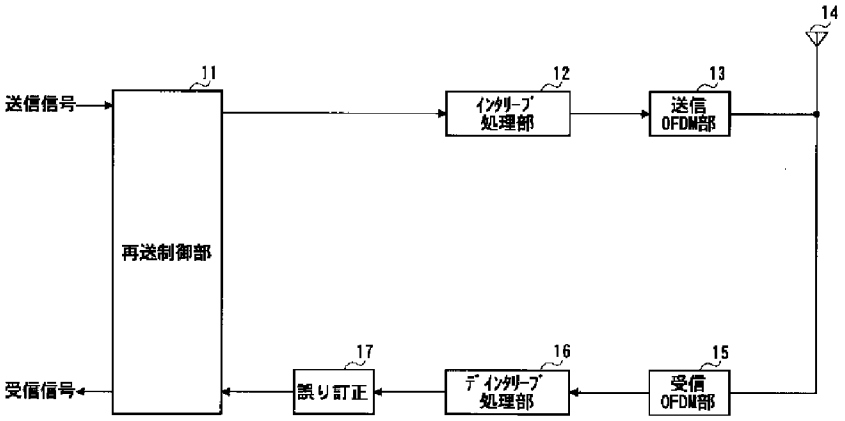
【符号の説明】

１０１　再送制御部
１０２　第１インタリーブ処理部
１０３　第２インタリーブ処理部
１０４　セレクタ
１０５　送信ＯＦＤＭ部
１０６　アンテナ
１０７　受信ＯＦＤＭ部
１０８　第１デインタリーブ処理部
１０９　第２デインタリーブ処理部
１１０　セレクタ

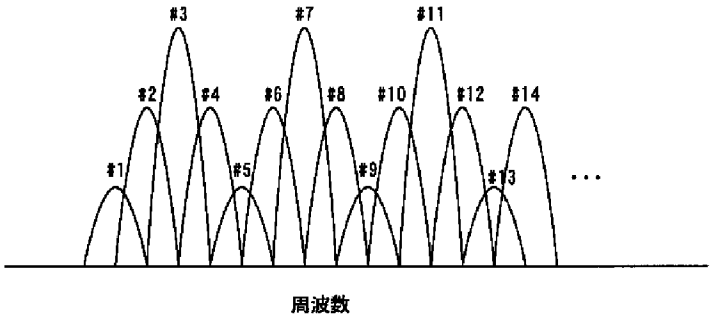
【図１】



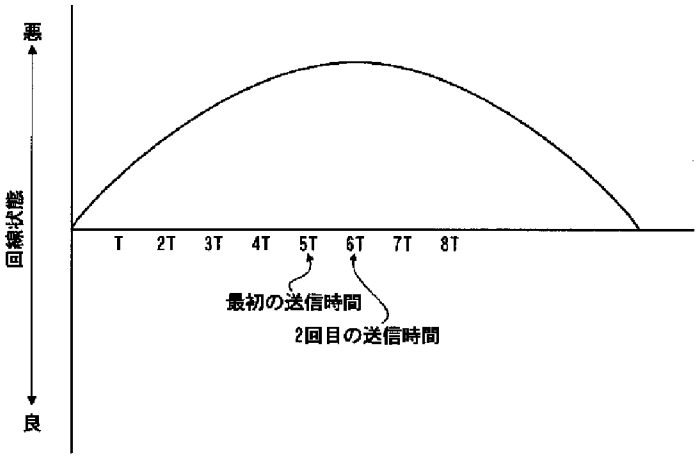
【図2】


14
11
12
13
送信信号
インタリーブ処理部
送信OFDM部
再送制御部
17
16
15
受信信号
誤り訂正
デインタリーブ処理部
受信OFDM部

【図3】


#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12
#13
#14
周波数

【図4】


悪
回線状態
良
T
2T
3T
4T
5T
6T
7T
8T
最初の送信時間
2回目の送信時間